

## **ADD Cards Provide Affordable DVI and TV-out Support for the Intel® 845G/GL Chipset**

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### Overview

ADD (AGP Digital Display) cards enable system builders to deliver to their customers value-added video and multimedia flexibility, without the added cost of an AGP graphics card. Connecting through the AGP (Accelerated Graphics Port) connector on the motherboard, ADD cards provide a low-cost way to add a DVI (Digital Video Interface) port and TV-out functionality. The ADD card is designed to work with Intel® Extreme Graphics implemented in the Intel® 845G/GL chipsets (see "New Intel® Desktop Boards Integrate Intel® Extreme Graphics" in this issue).

The Intel 845G/GL chipsets both have one dedicated analog display port, which is used for normal VGA CRT monitors, and two Digital Video Output ports (DVO-B, DVO-C), that are multiplexed with the dedicated AGP port. ADD cards plugged into the motherboard enable connections to digital flat-panel displays, televisions, and other devices.

ADD cards can work together with the onboard graphics of the Intel 845G/GL chipsets to enable synchronous display support, allowing the display of identical images on separate monitors. Note that the Intel 845G/GL chipsets cannot drive different data or timings on different monitors simultaneously, but it can work in conjunction with a PCI graphics adapter used with the Microsoft Windows\* extended desktop. There is no synchronous display when a TV output device is attached.

The digital ports support protocols including TV encoders, external digital-to-analog converters (DACs), Low Voltage Differential Signaling (LVDS), and Transition Minimized Differential Signaling (TMDS). These protocols support devices such as flat-panel monitors, low-voltage digital screens, digital video interface devices, standard-definition television (SDTV), high-definition television (HDTV), and digital cathode-ray tubes (dCRTs).

For system integrators, ADD cards provide a variety of display options and offer easy platform customization for multiple motherboard SKUs based on the Intel 845G/GL chipsets, with plug-and-play compliance.

### Functional Description

Digital Video Out (DVO) is a proprietary bus/protocol for connecting third-party transmitters to Intel® graphics chipsets, specifically Intel® D845G/GL chipsets. Each display port has control signals that may be used to control, configure, and determine the capabilities of an external device. The Intel D845G/GL chipsets route two 12-bit multiplexed DVO ports (DVO-B, DVO-C), each capable of driving a 165-MHz pixel clock to the AGP connector.

Each 12-bit port is capable of driving a digital display with a resolution of up to 1,600x1,200 at 60 Hz. Figure 1 shows a DVO-B port connected to one transmission device. The AGP bus has two signals on pins A-50 that are multiplexed together. These act as a strap and indicate whether the interface is in AGP or DVO mode. If an ADD card is present, the signal will be pulled low on the ADD card and the Intel 845G/GL chipsets will operate in the DVO mode.

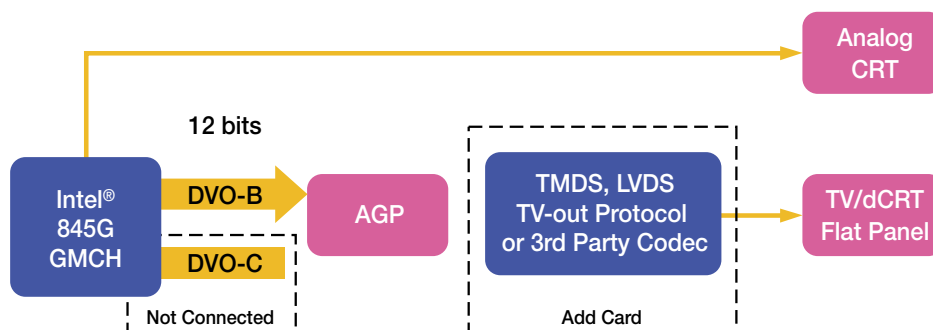


Figure 1. Digital Video Out (DVO) using one 12 bit port.

As shown in Figure 2, digital display ports can operate in either a 12-bit (single-channel) mode or in 24-bit (dual-channel) mode. In dual-channel mode the Intel 845G/GL chipsets' transfer rate capabilities are doubled, to enable driving a 24-bit 330-MHz pixel clock and a flat-panel display resolution up to 2,048x1,536 at 60 Hz, or a digital CRT (dRGT) up to 1,920x1,080 resolution at 85 Hz. The Intel 845G/GL chipsets are compliant with the Digital Visual Interface (DVI) specification, revision 1.0, and all ADD cards are designed to fit a 1.5V AGP connector.

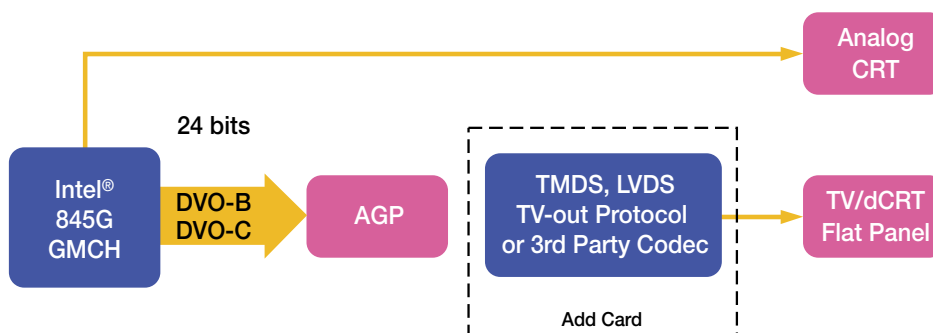


Figure 2. Digital Video Out (DVO) using one 24 bit port.

## Display Devices

ADD cards provide interfaces with a variety of devices, including:

- A discrete TV encoder to enable platform support for TV-out
- A discrete TMDS/LVDS transmitter to enable platform support for DVI-compliant digital displays
- An integrated TV encoder and TMDS/LVDS transmitter.

All ADD cards will have one or all of these support devices. Each protocol will support different display devices, such as Digital Flat Panel, TV-out.

Intel 845G/GL chipset-based TV-output devices, although not digital displays, utilize a digital display channel to communicate with a TV-out transmitter, and feature full support for standard definition formats, including NTSC/PAL/SECAM. Each can be configured as the boot device since the Intel 845G/GL chipset-based TV-out interface is addressable as a master device. This allows an external TV encoder device to drive a clock signal that is used as a reference frequency for the Intel 845G/GL chipsets. The frequency of this clock is dependent on the output resolution required. The external encoder is responsible for generation of the proper format signal. Table 1 outlines the different display port characteristics.

Interface Protocol	Analog	Digital Port B	Digital Port C
	RGB DAC	DVO 2.0 12 bit	DVO 2.0 24 bit
Control Bus	DDC1/DDC2B	DDC2B	
External Device	No	TMDS/LVDS Transmitter/TV Encoder	
Connector	VGA/DVI-1	DVI/CVBS/S-Video/Component/SCART	
Special Function	Monitor Sense	LCD Display Detect	

Table 1. Display Port Characteristics

## Software Considerations

Each ADD card can support a programmable read-only memory (PROM) device, which provides the subsystem vendor, revision, and device identification for each third-party device. Each ADD card manufacturer must provide a unique identification code. The motherboard BIOS will read the PROM on the ADD card and identify all subsystems. There are two bits available for subsystem and revision ID, and four bits for device ID.

AIM, here short for Add-In Module, is part of the graphics driver infrastructure for third-party codecs attached via the DVO port on Intel 845G/GL chipsets. In a system with an ADD card, when the operating system is loaded, it will detect that the ADD card is in use and will ask for the AIM driver to be installed.

Since the AIM module is part of the Intel® graphics driver, any change or update needed for ADD card functionality will be integrated into the driver. Each ADD card manufacturer will have a different AIM module supported through the graphics driver.

## Summary

The ADD card enables the Intel Extreme Graphics core to have DVI and TV-out functionality. Until now, DVI and TV-out functionality have only been available through discrete AGP and PCI add-in graphics cards.

Connecting via the AGP slot on the Intel® desktop board, an ADD card complements Intel Extreme Graphics integrated in Intel 845G/GL chipsets. The cards provide a DVI connector used in many flat-panel displays and high-definition TVs.

For standard-definition television, the cards also feature S-video and composite video TV-out connectors in NTSC/PAL/SECAM formats. Adding digital display functionality with a low-cost ADD card helps system integrators provide “flat-panel-ready” and “TV-ready” PCs that users can connect quickly and easily, right out of the box.

## More Info

To learn more about [AGP digital display cards](#), please visit the Intel desktop boards Web site. To find out more about the new [Intel desktop boards featuring Intel Extreme Graphics](#) go to the Intel desktop boards Web site.

### **Author Bio**

Steven Dettwiler joined Intel more than 11 years ago. He began in the motherboard design group, working on projects such as 386Hi. He later joined the Desktop Platform Solutions Division, where he has worked on Intel® TC430HX, AL44LX, AR440BX, and VC820 products, in addition to the current generation of motherboards based on the Intel 845G/GL chipsets. Steven also participated in the successful launch of 4XAGP and RDRAM\* technologies. He received his B.S. in engineering from the Oregon Institute of Technology.

*—End of Intel Developer Update Magazine Article—*